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See Page 11.

The A.S.T.E. Journal

Official Publication of the
AMERICAN SOCIETY OF TOOL ENGINEERS

NORTON

Contributes to Industry

As far back as

1877. Franklin B. Norton patented a new grinding wheel. (Emery bonded by the vitrifying process.)

1893. Introduced grinding wheels of natural Corundum. (India, later Canadian and South African Corundum.)

1897. Introduced the India oilstone taking the place of the natural mined product.

1900. Norton Grinding Machines patented—stepped-up production—awarded John Scott Medal.

1901. Introduced and developed a new artificial abrasive of unusually high quality for precision grinding, called Alundum Abrasive—also awarded John Scott Medal.*

And then in

1904. Water cooled electric furnace invented and patented by Aldus C. Higgins, President of the Norton Company, resulting in revolution of production of Alundum Abrasives—also awarded John Scott Medal.

1904. First automatic production grinding machines for crankshafts and camshafts.

1910. Production of white Alundum Abrasive of exceedingly high purity.*

1911. New high-grade refractory product introduced for laboratory use.*

1913. Precision grinding machine for shaping and sizing work in one straight-in-cut operation.

1917. Introduced highly efficient non-slip and wear resisting floors.*

1920. Automatic Grinding Machine.*

1921. Norton Pulpstone for grinding wood into pulp for newsprint.*

1924. Developed porous diffuser plates for modern sewage disposal plants.†

1929. More stable and dependable type of bond for vitrified grinding wheels.*

And now

1930. Diamond Grinding Wheels (Bonded Bortz.)†

1930. Unique method of wheel manufacture—controlled structure, which goes far toward making grinding a science instead of an art.*

1931. A grinding machine for automatically sizing the work.*

1932. Conjugate Grinding Machine for grinding all the cams of a camshaft at one time.*

1934. Introduced Boron Carbide (B_4C) hardest known substance except the diamond.*

*Patented †Patent Applied For

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and the reason for NORTON'S FIFTY YEAR OLD LEADERSHIP

NORTON COMPANY • WORCESTER • MASSACHUSETTS

The A.S.T.E. Journal

Published on the First Thursday of Each Month for the

AMERICAN SOCIETY OF TOOL ENGINEERS

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Vol. III January, 1935 No. 9

O. B. Jones, Editor Roy T. Bramson, Bus. Mgr.

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APPLICATION BLANKS AND INFORMATION PERTAINING TO MEMBERSHIP IN THE AMERICAN SOCIETY OF TOOL ENGINEERS may be had by addressing The A. S. T. E. Journal at above address or the Secretary's office, 8316 Woodward Avenue, Detroit, Michigan.

BE SURE TO READ IN THIS ISSUE

	Page
January Meeting	5
Production Perspectives	6
Education In Industry	7
Recent Patent Grants	9
Pointers on Purchase of Welding Machines	11

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Fig. 1 Fig. 2

For SERVICE and ECONOMY-- SPECIFY ECLIPSE

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   (For average spotfacing and counterboring)
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   (For two-piece Core Drills)

Send us your blue prints or specifications —our Engineering department will promptly make layouts and recommend proper tool-ups for your high production operations without obligation.

Fig. 3 Fig. 4

Factory representatives in all industrial centers.

ECLIPSE COUNTERBORE COMPANY

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JANUARY MEETING

(DETROIT)

HOTEL FORT SHELBY BALLROOM

January 10th (Thursday)

DINNER: 6:30 P. M.

MEETING: 8:00 P. M.

"Uses and Fabrication of Magnesium Alloys"

With Illustrations and Exhibits

Speaker: A. W. WINSTON

Chief Metallurgist, Dow Medical Company

Midland, Michigan

This meeting will be one of the high-lights of the season. The speaker well known in the industrial world is very well qualified to speak on the subject he has chosen. The information which Mr. Winston has to give is of primary interest to production technicians at this time. No doubt Mr. Winston will give some details relative to the Piccard-Compton Strathosphere Ascension. Dowmetal, as you know, was used in the construction of the gondola.

Come early and bring a friend.

Special entertainment talent in connection with this meeting is annouced by the entertainment committee.

To participate in the prize drawing make your reservations *in advance.* Tickets purchased at the door will *not* entitle you to participation in the prize drawing.

PRODUCTION PERSPECTIVES

● ● ●

The recent holidays were certainly enjoyable, we gather, from what we have seen of A. S. T. Eers here and there . . . . like one good member we saw eating *only* a *sandwich* in his favorite "sea-food" restaurant on Second Boulevard in Detroit the day after Christmas . . . . and it's not like *him* to be eating only a sandwich. But all this "time out" for celebrations caused much scurrying in production the last few days of the old year. In spite of the lack of sponsorship by the Automobile Chamber of Commerce of the auto show, there was again this year the usual last minute rush to get new models in readiness. **PACKARD** will be in production on the new lower priced model about **JANUARY 15TH** . . . . **CHRYSLER'S JEFFERSON PLANT** about **JANUARY 10TH.**

There is little kidding about the new year being better . . . . new car production estimates for the year now reach 3,500,000 . . . . **FORD ALL SET,** we hear, for a **DAILY PRODUCTION OF 5,000 UNITS DURING THE ENTIRE MONTH OF JANUARY.** The A.S.T.E. Secretary reports a marked scarcity of technically trained production men . . . . in fact the demand now exceeds the supply . . . . **JOB SHOPS** in the Detroit area report **GOOD BUSINESS IN DECEMBER** and with an **EXPECTANCY OF MUCH BETTER BUSINESS IN JANUARY.** General Motors of Canada is going strong, too . . . . Chevrolet scheduled for a daily production of 350 units—busier than they were even five years ago . . . . things must be looking up in other parts of the world, for most of these units will be shipped to the British Empire outside of England . . . . Canadian offices very busy these days working on export papers . . . . and, **FORD OF CANADA** is also busy getting ready to ship all over the British Empire as well.

Our old friend **JOHN T.** (Jack) **WHITAKER** who was until recently assistant to Mr. Roy (Louie) Peed of Chrysler has been made assistant to the general manager of the **ROSS GEAR AND TOOL COMPANY** of Lafayette, Indiana who manufacture the Ross Cam and Lever Steering Gears.

AIR CONDITIONING showed an encouraging increase in 1934 and promises a **CONSIDERABLE EXPANSION IN 1935.** This means more markets for refrigeration equipment. **FRIGIDAIRE** in Dayton has **RETOOLED** its two plants and **INSTALLED NEW MACHINERY** costing more than a million and a half in anticipation for 1935 better business . . . . anticipating production of half a million units.

Fourteen new members were elected at the last Board of Directors' meeting at Detroit headquarters . . . . they are **HOMER BAYLISS** with Motch & Merryweather, **JOHN BEACH** with Packard Motor, **L. C. BLOOD** with Goddard and Goddard, **C. F. CLARK** with Packard Motor, **W. C. FORD** with Ingersoll Milling Machine, **HAROLD FREDERICKSON** with Pioneer Engineering and Manufacturing also **FRITZ MITSCHE** and **ROGER WALSH** of the same company, **J. W. HANSEN** with Michigan Tool Company, **DAVID KRONKE** of Packard, **WALTER KROY** and **HENRY ROURKE** of Ford Motor Company, **RAY H. SMITH** with Saylor-Beale and **H. L. WELSH** with Vanadium Alloys Steel Company. A.S.T.E. welcomes these new men and urges them to take part in the many varied activities of The Society.

EDUCATION IN INDUSTRY

★ *by* SAMUEL F. WILSON
Hudson Motor Car Co., Detroit

Owing to limitations of space in this issue of The A.S.T.E. Journal, all three adresses given at the December meeting of The Society cannot be printed in their entirety. However the more important points of the technical discussion by Mr. Rylander and the Address of Mr. Lucius E. Wilson on "Money" are covered in the review at the bottom of this page.

"I am going into the subject of industrial education as one that is too big to be handled in a discussion of this kind, if we tried to cover the whole field. So I will confine myself to the subject of education in relation to engineering and shop work as related to tool work, because the industrial education of course, is known in all the different trades and arts for a good many years and it is always a matter of discussion in the factories as to whether the industrial training that we give the students and apprentices isn't sometimes a lot of bunk with the technical and trade schools and colleges there are available. It sometimes is questionable as to whether anything can be gained to taking the education out of the schools and putting it in the shops. In my estimation, the only reason for putting education in the shops and taking it out of the school is to carry on the shop work that the schools try to. They are trying to cover the field in a very wide field and naturally they can't cover any one phase of it such as is needed for tool engineering.

"For instance, most of the shop training is along the line of apprenticeship courses and the principle object of it is to make mechanics and when we try to make a mechanic for the tool room, most of the training is confined to the tool room operations. When we take a man that has had some technical training and give him the shop experience, then we are getting into the engineering field. The engineer has to have at hand a good deal of data pertaining to things that have already happened in the industry, things that have been done many times over and have been proven to be a fact. Then he must learn to take these facts and build things in such a way that he can improve on the things that have already been made. He has to have a certain amount of skill that I don't believe any of the colleges or trade schools can give with the same degree of accuracy that a regularly organized training school in a shop can give.

"In the first place, the men that are selected to take the training in a shop course have got to be particularly fitted for that class of work. They must have had quite a wide experience in the particular work they are working on. By experience I don't mean the merely number of years they have been at the business. That is sometimes confused with proficiency. The man that has had the specific training for the work he is trying to teach will accomplish more than an instructor in a technical school who has probably covered a great deal of ground but not any of it thoroughly for any length of time.

"What I am trying to make clear is that proficiency is only individual skill in the work and is present usually in the man who has come up from the shop. When we turn a student over to a shop man for training in this particular line, there must be outlines made as to the routine of the work. The ordinary apprentice that all shops have is usually started off on a lathe or milling machine or shaper and is given a job to do and a certain amount of instructions by the foreman and told what operations are necessary to complete the job and eventually he gets proficient enough to be moved to some other kind of a machine. Eventually he gets around the shop and has completed a certain

EXTRUSION OF PLASTIC METALS

By A. E. Rylander

Broaching has advanced from an operation to form odd shaped holes, keyways etc. to an operation, now, of major importance in the removal of metal. Likewise extrusion—which has had a very limited field—will soon take its place as a major operation in the forming of metals. Extrusion, ordinarily a simple process is sometimes difficult under specific conditions. Typical examples of extrusion, such as macoroni, lead pipe, tubing, insulated wires etc. lead one to think of the process as one of "pushing something out" which isn't entirely true for in some cases it becomes a process of percussion. Mr. Rylander then illustrated on a black board the different types of extrusion and showed the different methods used in extruding metals and rubber.

MONEY

By L. E. Wilson

Mr. Wilson believes, he stated, that the American government's actions to cure the depression are as intelligent and as far reaching as the public will allow. He likened the credit system of today to a ball of yarn which is constantly growing larger with interest, entangling people in its mesh. Money of itself has no value—only as the medium of exchange—yet its control by some sixty-four men stiffle credit with the resultant depression conditions for the masses. In previous depressions Americans moved westward—now, however, natural resources of the country are gone, and we must stay where we are and work this thing out. Mr. Wilson answered a number of questions from members and ended his address with the statement "I don't want to let the meeting end on a note of defeatism. We can do what we want to do with the government just as soon as we rescue it from the hands of a privileged few and put it in the hands of the American people."

number of hours or months of experience and is then supposed to be a mechanic.

"This journey-man has at the same time been receiving some technical training. He is then in line for some designing work. He is then turned over to the drafting room for further training. I don't know just how to make it clear that the foreman in the shop is not always the best instructor for men that have had technical training. It is all right for the ordinary apprentice going through the shop who has had no technical training to take the routine; but the man who has had the technical training to get the most out of the work has got to have an outline of work that will be more specific and by this, what you call individual training, the same amount of education can be imparted in a period of one year that would take four years in college.

"Now, this is just an observation of mine through fifteen years of application and observation of students being taught all the parts of tool making trades as well as foundry and pattern work and mechanical drafting and everything that goes into education of a tool designer.

"What I am trying to ask you fellows to do is to encourage the industrial education by getting the different factories and places that employ help to put their training on a basis that will get them together so that they will all follow the same routine and outline. As it is now, there are training schools at the Ford Trade School, Cadillac and every large manufacturer has some sort of a training school—whether it is recognized as such is another thing.

"The first school I had anything to do with was the Cadillac School of Applied Mechanics in 1912. Our system was to take students, graduates of high schools, and we have—or had—a training room with all of the different kinds of machines ordinarily found in a tool room. The student was brought in and turned over to an instructor who was especially proficient in that work, given very intensive training for one month. He wasn't just turned loose on the machine and told to do the job. Every time he was given a job, the job was outlined to him in such a way that he knew all the reasons for doing it that way and not doing it any other way. In fact, he was shown all the other wrong ways as well as the right ways and at the end of one month's time that student was turned over to the production department. All the lathe work was done in one department and milling machine work done in another department and drill press work, etc. He was turned over to one of the production departments for a period of three months to work. When he went out there, he wasn't just turned loose and forgotten for about three months; but every day the instructor would go round and have more or less conversation with him regarding the kind of work he was doing and why the cutting tools were made in a certain shape.

"One of the experiences we had at that time was the attitude of the foremen towards anyone coming into their department and talking to the students regarding their work or questioning them regarding the methods of doing the work. There was a natural resentment, they thinking that the instructors were checking up on their ways of doing work. That was probably the hardest thing we have had to overcome—to get the foremen in the shop to realize that we were trying to help them as much as the student. The student was there to learn all he could and not carry tales to someone else about the foreman's work.

"After a period of three month's time, he was brought back into the training room and put on another machine. The same process was carried out for this machine and then he was put into that production department and helped by the instructor as before. By the time he completed that course, he was then ready to go into the drafting room. He had an instructor that talked with him every day and discussed with him the things he had learned. And that school, I think, was about as near to the ideal type of training school I have ever seen for the class of students who have just gotten through high school.

"It was not designed to take the place of college. A man has had opportunity to go through college and get his degree of engineering. But when he comes out of college and he must have some place to go to get intensive shop training. Otherwise he is going to spend a great deal of time and a great many years perhaps accumulating experience. Some of us have spent too many years getting experience that we could have gotten in possibly one quarter of the time had there been some outlined plan we could have followed when we came out of school. For the student who doesn't have the chance of going through high school, the ordinary trade school is probably the best method of getting him started in the designing line. But, no matter what kind of school he comes out of, I believe there should be in every large factory a department that will take over these fellows before they are thrown in with the other fellows and allowed to fight for themselves.

"Usually a man has spent time to go through college, he is at the age where he has to begin to produce something. When he goes to apply for a position, instead of saying he doesn't know anything about the work and he would like to have someone help him with the education—he usually tries to get as much money as he can and he implies to the employers that he knows considerably more than he does about engineering work. With the result that he goes into the drafting room because he is too slow or hasn't any ideas. The engineer, of course, has to build on the things that are already known and building on to things that have been done before. This is particularly true in the tool line.

"You are all familiar with that. But in order to create or to have creative ability in designing new things, a man must be thoroughly trained in the fundamentals of tool making work and have a certain amount of knowledge of the technical end of the work.

"How can I help the training of young men? I am not running a factory or in a position to say we will install a training course in this factory. It is only by propaganda and discussing of the things of this nature that we can put the proper pressure to bear to provide and get the factories to provide

(Continued on page 9.)

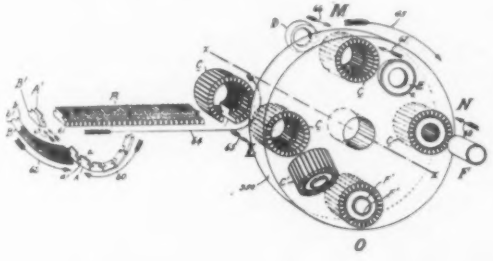
Recent Patent Grants Of Interest To The Tool Engineer

1,979,434

COMMUTATOR ASSEMBLING MACHINE

Russell W. Baker, John Q. Holmes, and Alva W. Phelps, Anderson, Ind., assignors, by mesne assignments, to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Applicatin November 21, 1931, Serial No. 576,494
126 Claims. (Cl. 29—84)



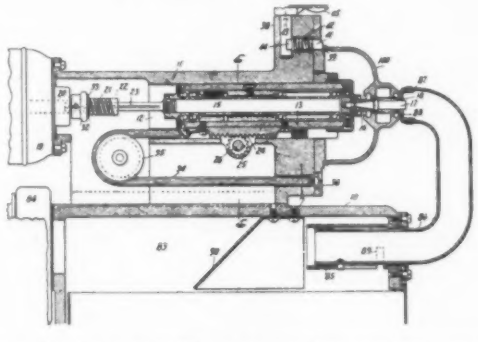
1. A commutator assembling machine comprising, in combination, means for assembling an annulus of segments of metal alternating with segments of insulation, said segments having anchoring tangs and means for assembling and securing therewith devices for binding the tangs of the segments together.

1,979,478

BORING MACHINE

George H. Leland, Dayton, Ohio, assignor of one-half to The Leland Electric Company, Dayton, Ohio, a corporation of Ohio

Application July 11, 1932, Serial No. 621,941
49 Claims. (Cl. 77—3)



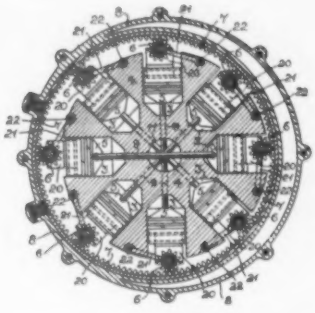
1. In a boring machine, a reciprocatory carriage, a cutter carried by said carriage, a shaft journaled on said carriage and connected with said cutter, an electric motor having a driving connection with said shaft, actuating mechanism for said carriage connected with said motor and including a magnetic clutch, a work support comprising a magnetic chuck, a work controlled switch mounted adjacent to said work support to prevent the operation of said motor and said magnetic clutch until the work is properly positioned on said work support, means controlled in accordance with the movement of said carriage to interrupt the operation of said motor and to de-energize said clutch and said chuck, and means to retract said carriage.

1,979,570

MEANS FOR THE HYDRAULIC TRANSMISSION OF POWER

Thomas Watson Paterson, Allerton, Liverpool, England

Application December 15, 1930, Serial No. 502,333
In Great Britain February 6, 1930
4 Claims. (Cl. 192—60)



1. Hydraulic torque transmitting apparatus embodying driving and driven shafts and means for changing their relative speed comprising on one shaft a casing provided with a guide track, and on the other shaft a rotor confined within said casing and provided with radially-disposed cylinders having intercommunicating ports and means to control the passage of liquid through said ports; and pistons accommodated in said rotor cylinders and directly connected in pairs by rigid connecting elements whereby reciprocation of any one piston will sympathetically effect corresponding reciprocal motion of its opposed piston without the agency of liquid in the apparatus; and rollable elements mounted on the outer ends of said pistons and maintained in operative engagement with said guide track of the confining casing by said rigid connecting elements of the pistons, said rollable elements being revolubly supported in bearing members movably mounted on the outer ends of the pistons and pivotally connected with said rotor to permit true reciprocation of said pistons within their respective cylinders.

EDUCATION IN INDUSTRY

(Continued from page 8.)

the proper training for men just out of school. That is the only message I have. I have been very much interested in the training of young men and you men are interested in your own trainning—otherwise you wouldn't be here. That is one of the objects in getting together, to help each other by your contacts with one another. You are still continuing your education because education never ceases.

"Have you given thought to the young men who are just starting out in life and have to take your places later on. Most of us are getting to the age where we have to begin to think of the younger men. If we only think of our own education and don't give any thought to how we are going to help anyone else, we are not accomplishing what we should. I would suggest that an organization of this kind could do an awful lot of good in promoting more industrial education in the factories. Thank you."

ENGINEERED PRODUCTION
EXAMPLES FROM THE SUNDSTRAND FILES
No. 3501

Lathes
Milling Machines
Tool Grinders
Centering Machines
Balancing Tools

Diamond-turning Oval Pistons On Sundstrand 6″ Stub Lathe

Turning a smooth, clean, fine finish on aluminum or aluminum-alloy pistons of oval section accurately and efficiently at the necessary high speed is a difficult problem. Sundstrand offers the solution in Model C Automatic 6″ Stub Lathe and equipment as shown in Fig. 1. This machine has spindle speeds ranging from 1000 r.p.m. to 3500 r.p.m.; rapid approach of tools to work, wide range of feeds, automatic tool relief, quick return, and stop. Details of tooling are shown in Fig. 2, in which W indicates the piston mounted at the end of master form or cam C. Diamond cutting-tool T is held in an oscillating holder on the front slide of the lathe. Follower F governs in-and-out-movement of the holder to reproduce precisely the shape of the master in the finished work-piece. Extremely accurate control of work diameter is provided by Disc D which has graduations approximately ¼″ apart. Turning D one division on its scale moves the cutting tool .0002″. Position of tool above or below center is regulated by the fine adjustment on yoke H. The ring-lands of this piston are not turned, tool rapid traverses to the point shown before beginning its cut. Ring-lands can be turned, truly round or oval as desired, by making the cam C of suitable shape. Usually cam C is made as long as the piston to be turned plus clearance at each end but in this instance it is somewhat longer to provide for turning pistons of other lengths.

Fig. 1. Sundstrand Automatic 6″ Stub Lathe for turning oval pistons with diamond tool.

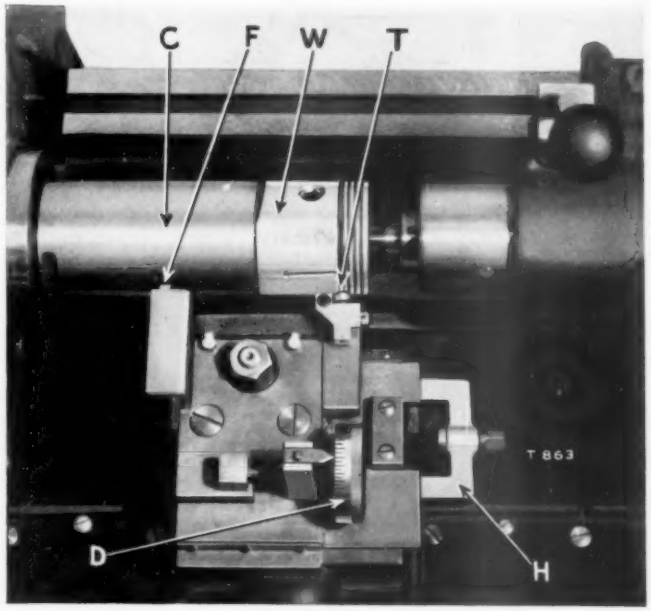
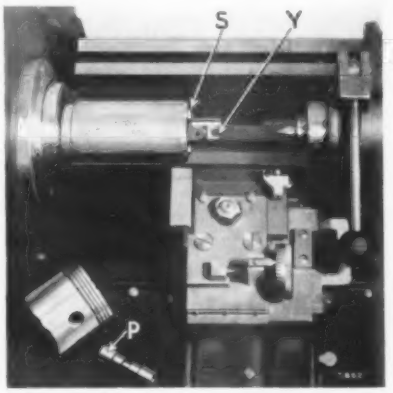


Fig. 2. Above—Close-up of tooling for lathe shown in Fig. 1.

Facilities for rapid handling and accurate locating of work are shown in Fig. 3. The operator slips pin P into wrist-pin hole of piston to be turned, places open end of piston in contact with beveled end of cam C so that pin P is engaged by yoke Y, moves ball-bearing spring loaded tail-center up to closed end of piston by means of quick-acting lever on the tailstock, starts automatic cycle. This is very fast, accurate, and simple. Screws S provide means for locating yoke Y accurately and securely with respect to the axes of the oval.

Fig. 3. Below—Piston removed to show method of mounting work.



As a result of several years development work on this operation we have valuable information on speeds, feeds, oval sections, diamond tools and their application to piston turning on Sundstrand Lathes. We shall be glad to discuss these details with all executives interested in high speed accurate turning of round or oval shapes with diamonds or other cutting tools.

STERLING - FRENCH MACHINERY CO.
NEW CENTER BUILDING ◆ DETROIT, MICHIGAN ◆ PHONE MADISON 3660
Exclusive Sales Representatives for Sundstrand Products in the Detroit Territory

POINTERS ON THE PURCHASE OF WELDING MACHINES

★ *by* **P. W. FASSLER**
Consulting Welding Engineer

TO master mechanics the purchasing agent, or whoever is deciding on the purchase of factory equipment, electric resistance welding machines present a real problem. The difficulty lies in the fact that he is not furnished with proper information on the electrical qualities of the machine. He is left in the dark on two most important factors. The first is the amount of current the machine is able to deliver on the job, that is between the electrodes or dies. The second is the amount of current it will draw from the lines. Both are governed by the power factor of the machine, a condition which is generally overlooked in the purchase of modern resistance welding equipment.

The power factor or as it is called in electrical terms, Cos. Phi, plays a very important part in all alternating current equipment. It is an indicator of the difference in phase between voltage and amperage. To understand its practical significance, we must keep in mind that a motor or transformer does not simply receive power from the generator continuously but only during a part of a "cycle" (1/60 of a second) whereas during the rest of the cycle it actually sends back power to the generator. We speak of a high power factor if the amount of power received is large compared to the amount sent back and of a lower or poor power factor if the amount received is not much larger than the amount sent back. In resistance welding machines power factors range from 0.15 or 15% to 0.75 or 75%.

In welding a certain amount of heat is required for a certain job. The welding machine converts power into heat. As we have only the net amount of power available which is the difference between the amount received and the amount received and the amount sent back, we can see that a low power factor set up requires much larger dimensions of transformers, switches, lines and power transformers for a cretain amount of heat delivered because all this equipment has to provide for the transmission of large powers back and forth.

This also explains the large amount of current a machine with a low power factor will draw from the lines. Since these welding machines increase from year to year in capacity such conditions will naturally become worse and to a certain extent alarming. In many cases the switches and power lines are inadequate and much money has to be spent on enlarging them. In some cases even additional transformers or generators have to be installed. If this is not feasible it is possible to correct bad power conditions by installation of so-called capacitors which are condensers and have electric characteristics which are the opposite of those of a motor or transformer and are able to correct a low power factor up to a certain extent. However they are very expensive and require much floor space.

The power factor of a welding machine depends largely on the nature of the job that has to be performed and also to a great extent on the design of the welding machine. While the calculation of the power factor of a resistance welding machine is exteremely difficult, once the machine is set up and running the power factor can be obtained easily by electrical measurements. The welding designer usually has enough experience to dimension his machine so that it will deliver enough current for a given job. But in most cases he is not able to determine in advance the amount of current the machine will draw from the lines and therefore the purchaser of the machine is left in the dark. If this occurs often as it does it will have an unfavorable influence on the total power factor in the plant. Voltage drops as an example, occur and cause great difficulty to the plant engineer or chief electrician and also the power supplier.

To avoid or at least anticipate these costly and troublesome difficulties, the purchaser of welding equipment should consult with his plant engineer and also demand more specific information on this point from the welding machine manufacturer.

We mentioned above that the power factor depends largely on the nature of the work. This, especially, is true of butt and projection welders. A machine with a relatively good power factor for a certain job will show a poor one when the steel masses which are between the electrodes or the size and number of embossments are increased.

This change in power factor is very hard for the average mechanical engineer to foretell and the men who are responsible for the line up of work that comes with a change in production, should ascertain beforehand, with reasonable accuracy, the effect of the proposed changes on their machines and power lines.

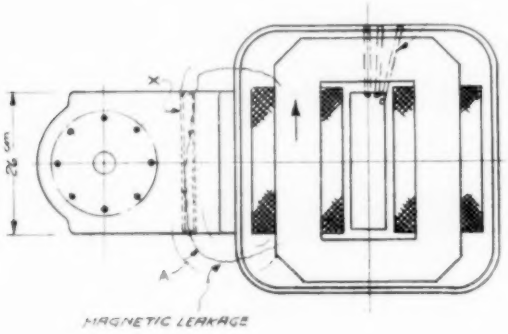
The men responsible for the equipment put in production should be able to buy electric resistance welding machines with the aid of more complete information than they have in the past. Under any circumstances they should know the power factor of such a machine before it is put in production. This would at least give them the possibility of checking the total power factor in their plants.

They should also be properly informed as to how many KW this machine uses per weld. So far this important factor has been neglected and for that reason many unpleasant occurrences have been cre-

ated through improper selection of suitable welding equipment.

This raises the responsibility so much more for the men who have to say the last word in buying such equipment. To illustrate what happens if welding machines, are not properly selected let us analyze two 300 KVA projection welding machines of different power factors. Even among welding machine experts there are many different view points about the current required per foot for projection welding. Some of them advocate 80 KVA per spot on ⅛" stock, some 50 KVA and others only 20 KVA. This indicates clearly that too much guess work is applied and that it is of great importance to analyze this proposition from a scientific view point which gives us concrete information.

As mentioned above in determining this in a proper way we depend largely on the size of the embossments, the mass of the material we have between the electrodes, the throat length of the electrodes and the reactance the transformer and the entire machine possesses.



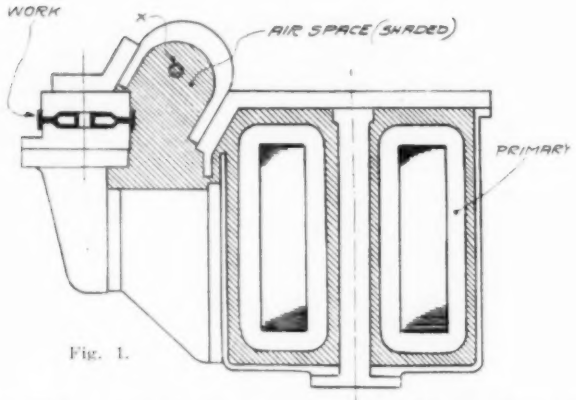


Fig. 1.

In Fig. 1 we show a certain machine where we are able to determine the reactance which depends largely on the area of the air space we have between the iron core, the secondary and the primary winding indicated by shaded lines. In a machine built in this manner a power factor was figured, (cos. Phi.) of 0.54 or 54%. We are now very much concerned as to what happens in such a machine which can be considered to be of high electric quality.

Therefore, we draw a voltage vector as shown in Fig. 2 and find the voltage available for the work. The reactance line shows 4.2 volt drop due to the reactance created by undesirable magnetic fields. The remainder, 2.7, is the heat producing voltage. We use 1.9 volts or 70% at the weld and 0.8 volts

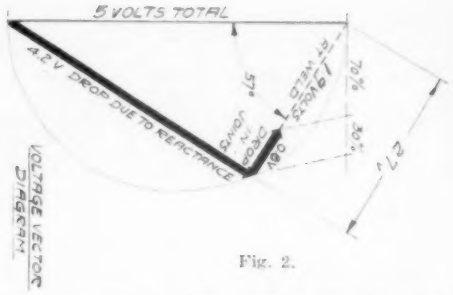


Fig. 2.

or 30% to overcome the resistance in the joints leads etc. In other words the welding machine industry should be able to design the welding machine in the same manner, for instance, as an engineer building a bridge where he has given facts, as span, wind pressure and load. This enables him to determine stresses and strain on each structure member, or the electrical engineer who designs a motor or generator where he is forced to predetermine the electrical characteristics.

The welding machine designer should part from guess work. He has to tell us how many KW and not KVA he needs to weld a certain job under certain conditions. Until then we always will be in deep water. We see projection welders in production with a power factor of 27% and some with 32% for the same job as discussed, which was eight embossments of ¼" diameter on 3/16" stock. What does this mean for a welding machine buyer?

A 300 KVA machine with a power factor of 54% produces:

KW = 300 x 0.54 = 162 KW.

In order to produce the same KW with a power factor of 32:

162 ÷ 0.32 = aprox. 500 KVA — are required.

Factors like this have naturally a great influence on the cost of such machines. Since it does not cost more to build a machine with a good power factor, as to build one with a low factor there would be some considerable difference in price between a 500 and 300 KVA machine. But as already mentioned in addition to this the high powered machine has a very satisfactory influence on the total power factor in the plants, which is of great importance. We take again, for instance, the same 300 KVA machine with a high power factor of 54% and weld larger work as shown in Fig. 3. The increase of this welding stock between the electrodes or the reactance field naturally increases our reactance line considerably and increases the angle Phi and it is figured that this machine had only a power factor of 0.36 or 36%. Therefore, it is advisable for any welding machine designer to take such conditions which naturally occur into consideration.

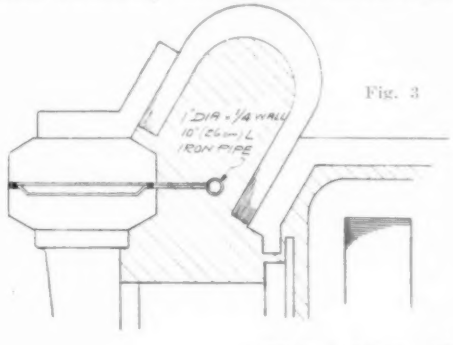


Fig. 3

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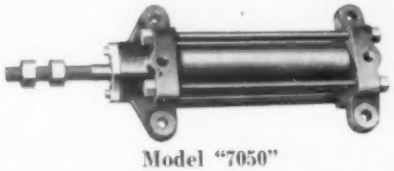

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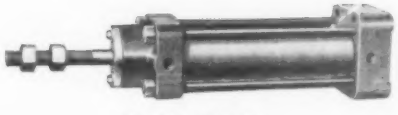

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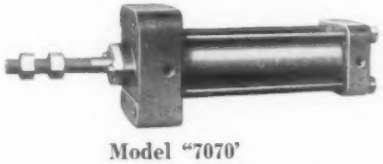

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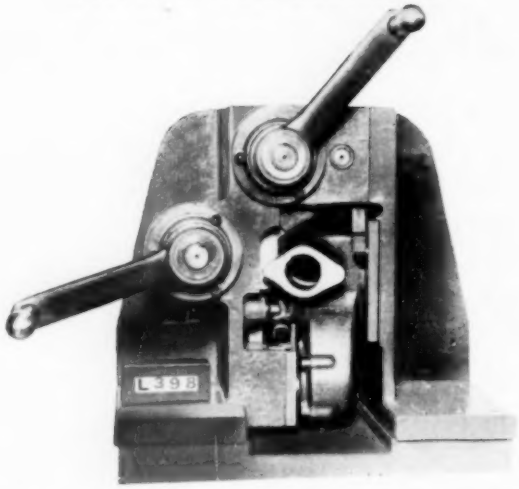

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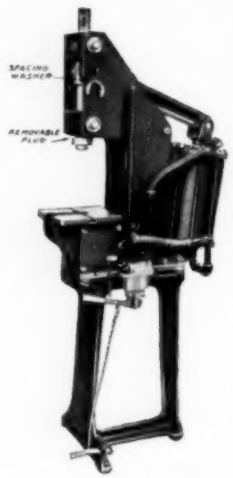

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Index of Advertisers

	Page
Colonial Bushings	13
Danly Die Sets	3
Eclipse Counterbore Co.	4
Ex-Cell-O Aircraft & Tool Co.	15
Heald Machine Co.	16
Logansport Machine Co.	13
Norton Company	2
Sturdimatic Tool Co.	14
Sundstrand Machine Tool Co.	10
Swartz Tool Products Co.	14
Tomkins-Johnson Co.	14

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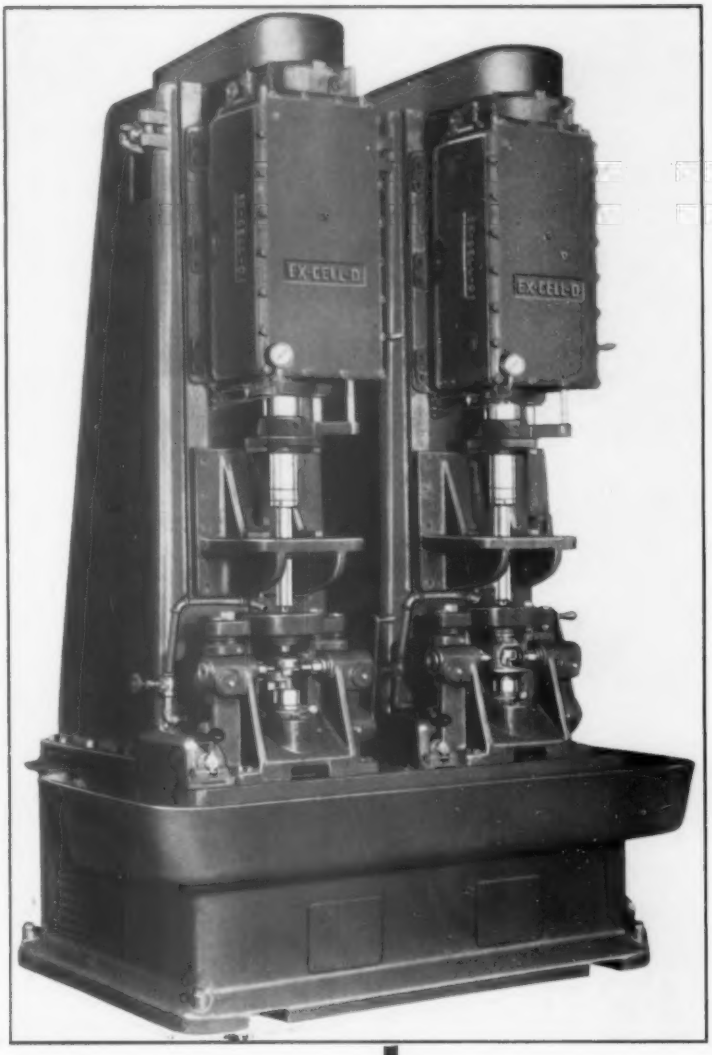

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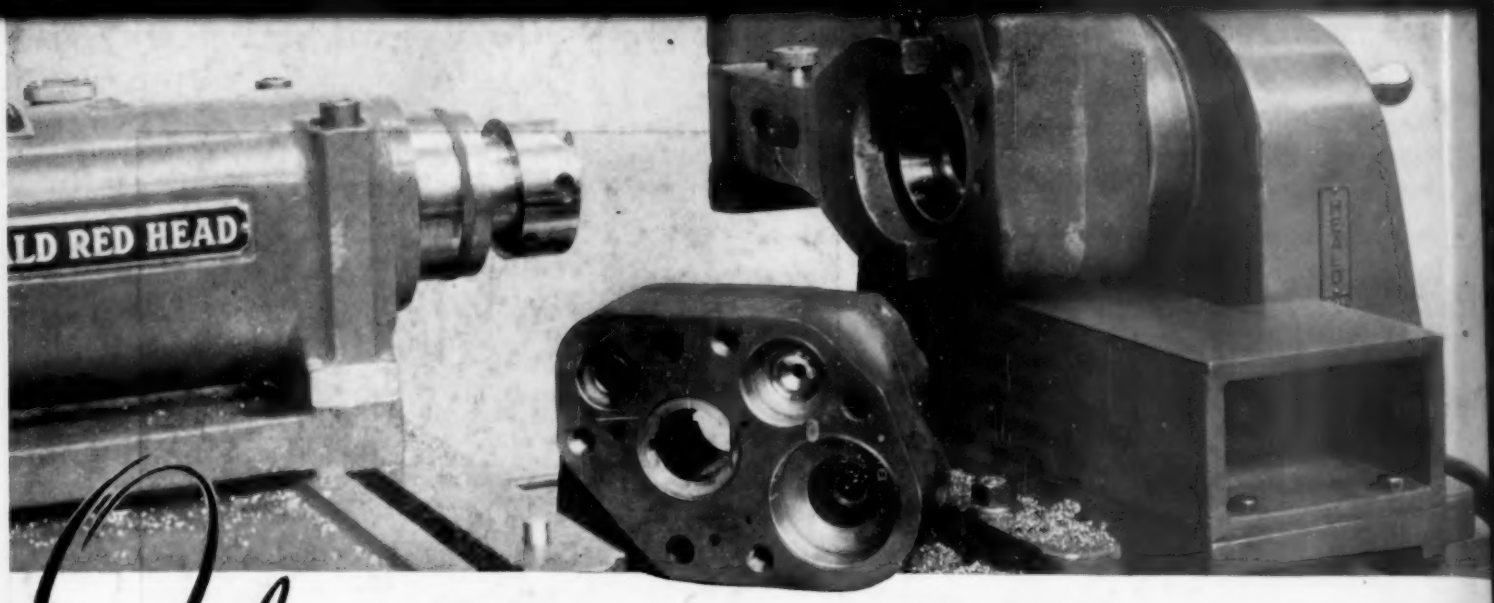

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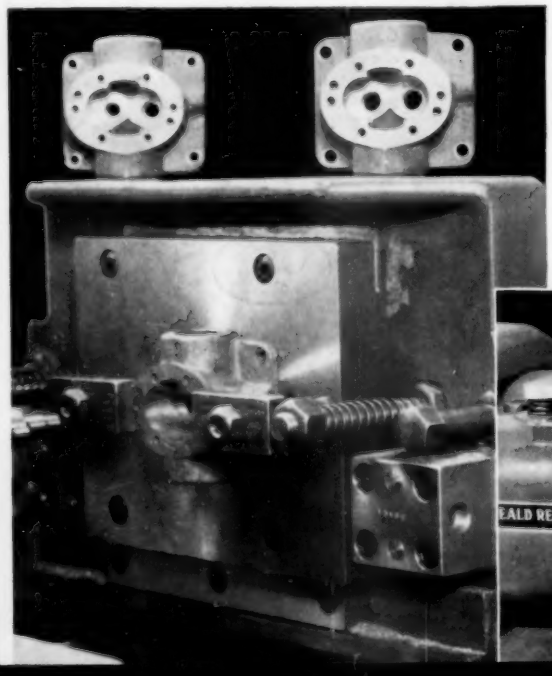

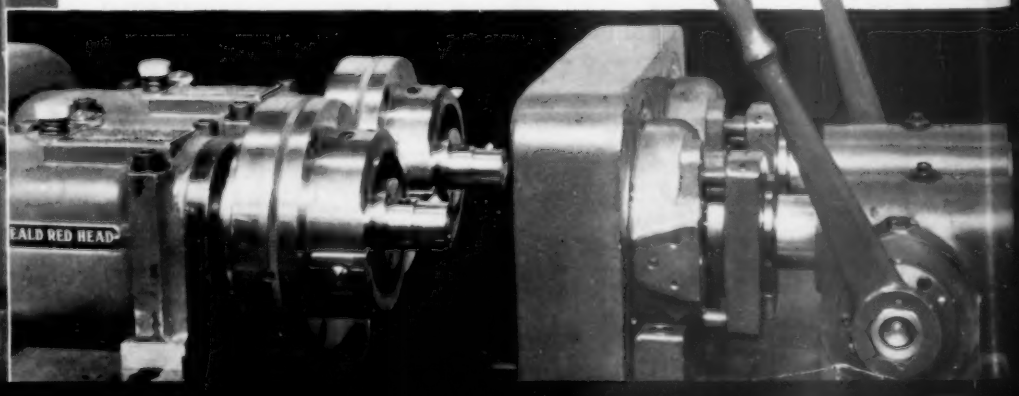

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